

**REMARKS**

Applicants amended claims 1 and 6 to overcome the rejections of the Examiner.

The Examiner made a first rejection of claims 1-4 under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al., U.S. Patent 6,270,573 (hereinafter Kitabatake) in view of Gruen et al., U.S. Patent 5,620,512 (hereinafter Gruen) and Shiomi, U.S. Patent 6,193,797 (hereinafter Shiomi) and Pickar, U.S. Patent 3,385,723 (hereinafter Pickar).

The Examiner made a second rejection of claims 1-4 under 35 U.S.C. 103(a) as being unpatentable over the above recited combination of references for the first rejection of claims 1-4 and further in view of Schultz et al., U.S. Patent 5,985,356 (hereinafter Schultz).

The Examiner rejected claim 5 under 35 U.S.C. 103(a) as being unpatentable over the above recited combination of references for the first rejection of claims 1-4 and further in view of Powell et al., U.S. Patent 5,195,194 (hereinafter Powell).

The Examiner made a first rejection of claim 6 under 35 U.S.C 103(a) as being unpatentable over the above recited combination of references for claim 5 and further in view of Fissel et al.

The Examiner made a second rejection of claim 6 under 35 U.S.C. 103(a) as being unpatentable over the above recited combination of references for the first rejection of claim 6 and further in view of Schultz.

Applicants respectfully assert that in making these rejections, the Examiner overlooks the language of the claims and the limitations recited therein. With the amendments to claims 1 and 6, applicants emphasize that their invention is directed to the solid source MBE technique. As amended, claims 1-6 recite a solid source method of

growing a homoepitaxial SiC film within an MBE system that is neither taught nor suggested by the prior art cited by the Examiner.

In responding to the Examiner's first rejection of claims 1-4, it is assumed that the references cited by the Examiner are intended to form a cumulative combination of references, rather than three sets of two reference combinations as literally stated in section 2, pages 2-4 of the Office Action. This is in keeping with the Examiner's recitation of the second rejection (section 6, page 7) wherein is stated "[t]he combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches all the limitations of claim 1, as discussed previously" (emphasis added). If not, the Examiner has failed in the first instance to state a *prima facie* case because each two reference combination fails to anticipate the elements of applicants' claim 1 when viewed in light of the others. For example, and based solely on the Examiner's admissions, a combination of Kitabatake and Gruen would fail to teach or suggest, *inter alia*, "coating a second crucible with a layer of SiC" and "charging a second crucible with a quantity of solid Si". Similarly, a combination of Kitabatake and Shiomi would fail to teach or suggest, *inter alia*, "charging a first crucible with a quantity of Fullerenes" and "coating a second crucible with a layer of SiC". Similarly, a combination of Kitabatake and Pickar would fail to teach or suggest, *inter alia*, "charging a first crucible with a quantity of Fullerenes" and "charging a second crucible with a quantity of solid Si". Thus, none of the two reference combinations anticipate applicants invention as claimed. Therefore, applicants respond to the first rejection based upon the assumption that the Examiner's citation of references was intended to be considered as a cumulative combination of references.

Turning now the Examiner's rejection of claims 1-4, the Kitabatake reference fails to teach or suggest applicants' invention because it is, first of all, not pertinent to the solid source MBE technique. Kitabatake teaches evaporating carbon atoms from an electron beam generator. The process taught by Kitabatake, CVD (Continuous Vapor Deposition) or gas source MBE is entirely different from the process described and claimed by applicants to the extent that those having skill in that art would not consider the teachings

and solutions of CVD and gas source MBE processes pertinent or analogous to the solid source MBE technique. For example, material deposition rates for CVD and gas source MBE techniques are markedly different than those of solid source MBE. Moreover, the local environment above the sample substrate is also markedly different, affecting materials, methodology and processes. This marked difference in technique is why, as noted by the Examiner, no mention is made of shutters in Kitabatake because shutters would not effect growth change in CVD or gas source MBE processes and thus are not useful to the technique.

The very first claim element, "charging a first crucible with a quantity of Fullerenes" recited in applicants claim 1 is absent in Kitabatake, as noted by the Examiner. In order to overcome this shortcoming, the Examiner cited Gruen in combination with Kitabatake as teaching the missing element. Here again, Gruen, like Kitabatake, is directed to an entirely different method of epitaxial crystal growth. While Gruen does teach the use of Fullerene, his method is directed plasma chemical vapor deposition (CVD) in which a carrier gas transports the Fullerene molecules to a highly energetic plasma environment for deposition onto a substrate. This is a completely different growth technique from solid source MBE because in Gruen's method, the reactant molecules (Fullerenes) are transported in a gas stream from a remote location to a high pressure environment where a chemical reaction occurs and energy is provided by means of a plasma rather than heat. Solid source MBE relies on local sublimation or evaporation of source molecules into a vacuum deposition chamber where they impact a substrate and react on the surface under the influence of energy provided by heat. Solid source MBE is inherently cleaner because no additional carrier gasses are present, but the materials, processes and methodologies are significantly different, and not considered analogous to gas source deposition techniques such as CVD or gas source MBE. And, it should be pointed out that there is no teaching suggestion or even mention in Gruen or, for that matter in the combination of Kitabatake and Gruen of "charging a first crucible with a quantity of Fullerenes", "installing said first crucible into a first effusion cell", and "placing said first effusion cell into the growth chamber" claim limitations positively recited in applicants' claim 1

In order to overcome the fact that Kitabatake and Gruen fail in combination to teach or suggest applicants' fifth claim element (in addition to those mentioned above), "charging said second crucible with a quantity of solid Si", the Examiner added Shiomi to the above combination references. Shiomi is directed to a non-analogous bulk growth technique wherein the chemistry and physics are markedly different from applicants' invention. Shiomi teaches a method of making a SiC crystal using a solid source of Si retained within a graphite crucible having diamond like carbon or glass-like carbon inner faces having a high smoothness (Col 7 Ln 24-28). Such a crucible is entirely unsuited to solid source MBE processes, as will be described below.

As applicants stated in their patent specification, a significant hurdle that must be overcome in order to use solid Si in solid source MBE is the fact that molten silicon will react with and dissolve whatever container it is in. Applicants' novel solution to this problem is to first coat the crucible with a coating of SiC prior to being charged with solid Si. This clearly recited in the fourth claim element "coating a second crucible with a layer of SiC". This claim element is neither taught nor suggested by the Kitabatake, Gruen and Shiomi combination cited by the Examiner.

In order to overcome this shortcoming, the Examiner added Pickar to the combination. Pickar teaches wetting the inner crucible surface with a sugar or glycerin binder solution. The binder solution is burned by heating to a pure carbon layer. Si powder is sifted on the carbon layer and the crucible heated in a reaction furnace to form beta silicon carbide. Pickar's method is not on point. Pickar is entirely different from applicants' method of coating the crucible with SiC and this difference is fundamental because applicants' novel coating technique provides a uniform SiC layer, critical for retaining molten silicon for solid source MBE. Pickar's process, on the other hand, fails to provide the requisite nonporous coating and accordingly is not a solution to the problem of containing molten silicon in a container.

As pointed out above, the combination of the four disparate prior art references suggested by the Examiner would not result in applicants' invention. Moreover, the Examiner's statement concerning obviousness is conclusory and does not adequately address the issue of motivation to combine. This factual question of motivation is material to patentability, and cannot be resolved on subjective belief and unknown authority. To establish obviousness, the Examiner must do more than identify the elements in the prior art. There must also be "some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead the individual to combine the relevant teachings of the references." See In Re Fine, 837 F. 2d. 1071, 1074, 5 U.S.P.Q. 2d. 1596, 1598 (Fed. Cir. 1988). Here, the Examiner has failed to provide a factual basis to support the legal conclusion of obviousness. The Examiner is expected to make the factual determinations set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 U.S.P.Q. 459, 467 (U.S. 1966) and to provide a reason why one having ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reason must extend from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. If a combination of two items of prior art is asserted to establish obviousness, the party asserting invalidity "bears the burden of showing some teaching or suggestion in these references which supported their use in combination." Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 293, 227 U.S.P.Q. 657, 664 (Fed. Cir. 1985). Applicants respectfully submit that there is no basis for the artisan to even consider the teachings of Kitabatake, Gruen, Shiomi and Pickar to be sufficiently related to result in their teachings being collectively considered in this case. The Examiner picks and chooses among elements of the prior art using applicants' claimed invention as a guide. This the Examiner cannot do. In Re Fritch, 972 F. 2d 1260, 1266, 23 U.S.P.Q. 2d 1780, 1783-84 (Fed. Cir. 1992).

Lastly, it should be understood that the combination of Kitabatake, Gruen, Shiomi and Pickar fails to teach or suggest "charging a first crucible with a quantity of Fullerenes", "installing said first crucible into a first effusion cell", "placing said first effusion cell into the

growth chamber", "installing said second crucible into a second effusion cell" "placing said second effusion cell into the growth chamber", "evacuating the growth chamber", "heating said substrate", "heating said first effusion cell", "heating said second effusion cell", and "growing a homoepitaxial layer of SiC upon said substrate by controllably actuating the effusion cell shutters", each of the above being claim limitations positively recited in applicants' claim 1.

Thus, it can be seen that the proposed combination of references by the Examiner fails to establish a *prima facie* case of obviousness because the prior art fails to teach or suggest the invention as claimed by applicants. The only motivation that could exist for making the combination suggested by the examiner is based on the teachings of applicants' own invention. The Examiner has, in essence, pointed to and combined specific elements found in the prior art without giving any motivation for their combination. There is simply no basis for the artisan to even consider the teachings of Kitabatake, Gruen, Shiomi and Pickar to be sufficiently related to result in their teachings to be collectively considered. "The mere fact that the prior art may be combined in the manner suggested by the Examiner does not make the combination obvious unless the prior art suggested the desirability of the modification" In Re Fritch, 972 F. 2d 1260, 1266, 23 U.S.P.Q. 2d 1780, 1783-84 (Fed. Cir. 1992). Here, the only motivation to pick and choose among elements from the prior art is based on the teachings of applicants' invention itself. Such hindsight analysis is entirely improper. Lastly, even if the combination suggested by the Examiner were somehow made, the combination would fail to teach, suggest or anticipate applicants' invention. The varied and disparate prior art references cannot be combined in any reasonable manner to result in the solid source MBE method of growing homoepitaxial SiC as described and claimed by applicants. In short, the references are simply too disparate to be combined for the purpose suggested by the Examiner and even if somehow combined, fail to anticipate applicants' invention.

Turning now the Examiner's second rejection of claims 1-4, it is respectfully submitted that the Examiner again fails to articulate a *prima facie* case. In this second

rejection, the Examiner recited the combination of Kitabatake, Gruen, Shiomi and Pickar above and added Schultz to the combination for the “feature of effusion cells with shutters, which is inherent to the molecular beam Epitaxy method of deposition”. As stated above, shutters serve no useful purpose in the gas source deposition techniques of the references cited by the Examiner. While Shultz at col 15, ln 65 to col 16, ln 15 does describe the general solid source MBE process including the use of shutters, he does so solely to provide background information to the reader similar to applicants’ own description of the MBE process on page 5 of the specification. Contrary to the Examiner’s assertion, however, the proposed addition of Shultz’s generalized description of solid source MBE to the combination of Kitabatake, Gruen, Shiomi and Pickar fails to teach or anticipate applicants’ invention. The Examiner has, in essence, pointed to and combined specific elements found in the prior art without giving any motivation for their combination. There is simply no basis for the artisan to consider the teachings of Kitabatake, Gruen, Shiomi and Pickar to be sufficiently related to result in their teachings so as to be considered appropriate for or amenable to combination. The addition of Shultz to the combination fails to provide a meaningful accumulation because Shultz simply recites a general description of the MBE process. There would be simply no expectation of suitability of the five reference combination for achieving the results obtained by applicants’ invention and even if the combination were somehow made, it would fail.

Concerning this second rejection of claims 1-4, applicants note that the combination of Kitabatake, Gruen, Shiomi, Pickar and Schultz fails to teach or suggest “charging a first crucible with a quantity of Fullerenes”, “installing said first crucible into a first effusion cell”, “placing said first effusion cell into the growth chamber”, “installing said second crucible into a second effusion cell”, “placing said second effusion cell into the growth chamber”, “evacuating the growth chamber”, “heating said substrate”, “heating said first effusion cell”, “heating said second effusion cell”, and “growing a homoepitaxial layer of SiC upon said substrate by controllably actuating the effusion cell shutters”, each of the above being claim limitations positively recited in applicants claim 1.

Applicants' submit that the subject matter of claims 2, 3 and 4 being dependent on claim 1 should now be considered allowable. Claims 2, 3 and 4 each insert additional limitations to the method of claim 1. Each recites operating temperatures appropriate to the solid source MBE method of applicants' invention. While somewhere within the overall descriptions of Kitabatake, Gruen, Shiomi, Pickar and Shultz temperatures apparently similar to those claimed by applicants may be found, the only motivation to pick and choose among these temperature figures from the prior art is based on the teachings of applicants' invention itself. Such hindsight analysis is entirely improper and fails to anticipate applicants' invention as claimed.

Turning to the Examiner's rejection of claim 5, the addition of Powell to the previously cited combination of Kitabatake, Gruen, Shiomi, Pickar fails to teach or suggest the invention as claimed by applicants. Similar to the shortcomings recited previously, Powell is concerned with a CVD growth process. Moreover, Powell teaches the growth of heterostructures over small areas, not uniform homoepitaxial films over an entire wafer surface as described and claimed by applicants. Powell's wafer preparation is predicated on etching with an H/HCL mixture within the CVD chamber with the sample temperature at 1000°C. This step is impossible to duplicate in an MBE chamber and thus is inapplicable to solid source MBE techniques. Quite simply, one having ordinary skill in the art would not look to a combination of Kitabatake, Gruen, Shiomi, Pickar and Powell for a solution to the problem of providing a solid source MBE method of growing homoepitaxial Silicon Carbide, because none are directed to the relevant technique. Moreover, the combination fails to teach or suggest a workable technique. Here again, the Examiner has failed to establish a *prima facie* case of anticipation.

Turning now to the Examiner's first rejection of claim 6, the Examiner states that applicants' invention is unpatentable over a combination of Kitabatake, Gruen, Shiomi, Pickar, Powell and Fissel. While Fissel is directed to a solid source MBE technique, Fissel differs markedly from applicants solid source MBE technique because Fissel teaches and describes an electron beam gun evaporation technique. Such a technique gives less than

desirable results because the flux generated by the electron beam is unstable and results in inconsistent material growth and is not a solution to the problem of providing high quality SiC semiconductor material, especially not homoepitaxial SiC. This express shortcoming is recited in applicants' patent application in the last paragraph of page two. Moreover, the addition of Fissel to the five reference combination fails to teach or suggest applicants' invention as claimed. Fissel does discuss a cleaning method but fails to anticipate applicants' invention according to the plain language of amended claim 6. To form this rejection, the Examiner picks and chooses among elements of the prior art using applicants' claims as a guide. The Examiner suggests that combining six disparate prior art references directed to non-analogous techniques, materials and methods would be obvious to one having ordinary skill in the art, yet points to no objective teaching in the references themselves. This is improper and the mere fact that the prior art may be combined in the manner suggested by the Examiner does not make the combination obvious unless the prior art suggested the desirability of the modification In Re Fritch, 972 F. 2d 1260, 1266, 23 U.S.P.Q. 2d 1780, 1783-84 (Fed. Cir. 1992).

Lastly, it is respectfully submitted that this first rejection of claim 6 by the Examiner fails to establish a *prima facie* case by the Examiner's own admission. While applicants will fully address the matter below, the Examiner notes in the second rejection of claim 6, that the combination of Kitabatake, Gruen, Shiomi, Pickar and Fissel "teaches all of the limitations of claim 6... *except the well known feature of effusion cells with shutters*" (emphasis added). Thus, the combination proposed by the Examiner of Kitabatake, Gruen, Shiomi, Pickar and Fissel fails in the first instance to anticipate the claims of applicants' invention.

In making the second rejection of claim 6, the Examiner suggests that applicants' invention is unpatentable over a combination of Kitabatake, Gruen, Shiomi, Pickar, Powell, Fissel and further in view of Shultz. The addition of Shultz to the combination fails to provide a meaningful accumulation because Shultz simply recites a general description of the MBE process. There would be simply no expectation of suitability of the now seven

reference combination for achieving the results obtained by applicants' invention. Shultz provides nothing except for a description of the MBE process. It is unclear how these seven references could be combined and even if the combination were somehow made, it is uncertain how such a combination could anticipate applicants' invention. As discussed above, the Examiner picks and chooses among elements of the prior art using applicants' claims as a guide. The Examiner effectively suggests that combining seven disparate prior art references directed to non-analogous techniques, materials and methods would be obvious to one having ordinary skill in the art, yet points to no objective teaching in the references themselves. Such showings by the Examiner are essential for the establishment of a *prima facie* case of obviousness. The features of applicants' invention, positively recited as limitations in claim 6, such as "cleaning said substrate with pressurized CO<sub>2</sub>", "etching said substrate", "rinsing said substrate", "and drying said substrate with pressurized N<sub>2</sub>", are simply not taught by the combination proposed by the Examiner. The Examiner has therefore failed to put forth a *prima facie* case of obviousness. Further, there is no basis for the artisan to even consider the teachings of Kitabatake, Gruen, Shiomi, Pickar, Powell, Fissel and Shultz to be sufficiently related to result in their teachings being collectively considered in this case. Instead, the Examiner picks and chooses among elements of the prior art using applicants' claimed invention as a guide. This the Examiner cannot do. In Re Fritch, 972 F. 2d 1260, 1266, 23 U.S.P.Q. 2d 1780, 1783-84 (Fed. Cir. 1992).

In view of the foregoing, it is respectfully submitted that the Examiner has failed to establish a *prima facie* showing of obviousness in applicants' invention. Claims 1 and 6, as amended, clearly patentably distinguish over the prior art cited by the Examiner and the Examiner is requested to allow the application as amended. Claims 2-5 being dependent on claim 1 add further limitation thereto should be allowed as well.

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Amdt. dated March 24, 2003  
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The references cited without reliance in the Examiner's Action have been considered and are deemed not to preclude allowance of the application.

Respectfully submitted,

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